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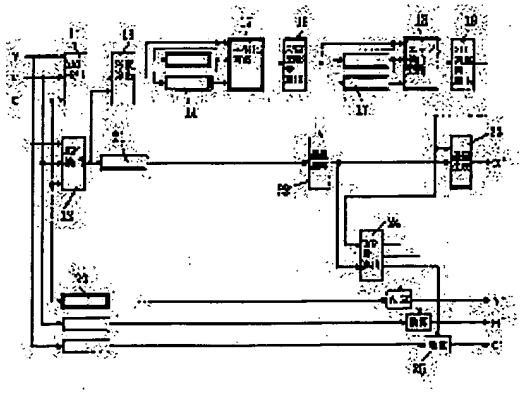
(72)Inventor : HIBI YOSHIHARU

## (54) COLOR IMAGE FORMING DEVICE

(57)Abstract:

PURPOSE: To suppress an undesired emphasis of a black edge produced in the vicinity of characters under a color background resulting from setting of a high rate UCR parameter.

CONSTITUTION: A saturation calculation circuit 13 uses an output of a MAX detection circuit 11 and a MIN detection circuit 12 to calculate max(Y, M, C)-min(Y, M, C) thereby obtaining a value corresponding to the saturation. After it is smoothed by a smoothing circuit 15, the saturation is given to an edge extract circuit 18 and an STP adjustment quantity calculation circuit 19, in which the adjustment quantity is obtained. A black amount generating circuit 23 and an undercolor removal amount calculation circuit 24 adjust the black amount production and under color removal quantity based on the adjustment amount and a start density is controlled depending on the obtained black amount and the under color removal amount.



LEGAL STATUS

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CLAIMS

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[Claim(s)]
[Claim 1] In yellow, a Magenta, cyanogen, and the color picture processor that forms a color picture using the color material of Japanese ink A means to detect the signal equivalent to the ink volume of an image, and a means to detect the signal equivalent to the amount of saturation of an image, Color picture formation equipment possessing a means to graduate the detected this amount of saturation, a means to detect the amount of edges of saturation using the this graduated amount of saturation, and a means to control the amount of lower color removal, and ink volume according to the amount of edges of the this detected saturation.
[Claim 2] In yellow, a Magenta, cyanogen, and the color picture processor that forms a color picture using the color material of Japanese ink A means to detect the signal equivalent to the ink volume of an image, and a means to detect the signal equivalent to the amount of saturation of an image, Color picture formation equipment possessing a means to detect the amount of saturation from this detecting signal, a means to detect the amount of edges of saturation using the this detected amount of saturation, and a means to control the amount of lower color removal, and ink volume according to the amount of edges of the this detected saturation.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to color picture formation equipments, such as a color copying machine, a color printer, and a color FAX, especially performs edge detection of saturation based on a saturation component, and relates to the color picture formation equipment which controls the amount of lower color removal by that amount of edge detection, and forms a color picture.
[0002]
[Description of the Prior Art] With conventional digital color picture formation equipment, processing in which the amount which generated the Japanese ink signal using the lower color removal (it is described as Following UCR) technique from the first yellow by which color correction was carried out in accordance with color material, such as a printer, a Magenta, and the color material of cyanogen, and balanced the Japanese ink signal from the signal of the first yellow, a Magenta, and cyanogen is reduced is performed. It is known that parameter design how much to put in Japanese ink from the concentration of which about will affect it greatly to the image quality of the color picture formed, the consumption of color material, the stability of image formation, etc. in that case. For example, if UCR of high rate (for example, 100%) is set up as a parameter from the low place of concentration, the cost merit that there is little consumption of yellow, a Magenta, cyanogen, and the total amount of color material of Japanese ink, and it ends will come out upwards, and the imprint effectiveness by reduction of the pile height of color material will improve. Furthermore in respect of image quality, there is a merit that the rate that improvement in gray balance, a black alphabetic character, etc. are permuted in black Isshiki becomes high.
[0003] According to the information on an image (a chroma, edge, etc.), the technique which controls the amount of amount UCR(s) of Japanese ink generation is known conventionally. For example, it is proposed by JP,62-15097,A, JP,62-103475,A, JP,63-18778,A, JP,63-114467,A, and JP,63-296946,A. Moreover, a means to detect the edge section of a color picture and to compute the amount of edges, and the technique which controls the amount of lower color removal according to BK concentration are proposed by JP,61-1171,A. Moreover, the technique controlled as compared with a setting threshold about the starting point which controls the amount of lower color removal and ink volume is indicated by JP,63-65780,A.
[0004]
[Problem(s) to be Solved by the Invention] When UCR of high rate (for example, 100%) is set up simply, by the way, the red of a color scanner, When the difference in each MTF (Modulation Transfer Function) of Green and a blue signal, the effect of location **** of delicate reading, etc. are large, as shown in drawing 1 for example, a manuscript which has the blue alphabetic character which is the yellow complementary color on a yellow background -- setting -- the provincial accent of the edge section -- exactly -- gray ** -- as **** was made inside, it may reappear When the filtering circuit which emphasizes an edge at the back process by which such a chrominance signal was generated is contained, the signal of the black of the periphery of an image which was mentioned above will be emphasized, and

there is a problem which produces an edge component which was trimmed with black around the color alphabetic character, and which is not meant. Furthermore, it may be conspicuous with the delicate register gap produced for every color version of the image output section (IOT), and there is fault of hurting the image quality of a reappearance image. In addition, "DF" in drawing 1 is a circuit (digital filter) which carries out sharpness amendment.

[0005] Furthermore, when the manuscript drawn up by halftone dot which is represented by the printing manuscript is read, the black signal generated from the gray pattern of a low period is emphasized from yellow, a Magenta, and the screen ruling that the halftone dot of cyanogen overlaps and produces, and there is fault which becomes like a kind of texture pattern. It is easy to generate especially these in the field of the high gray of the probability for the halftone dot of yellow, a Magenta, and cyanogen to lap etc. Moreover, obscuring in the spatial filter of the usual size is difficult for the present condition for a low period. Such fault points are a location not only with the example of an alphabetic character which was not necessarily mentioned above, and the example of a printing manuscript but the same image structure, and a trouble generated with the pattern on a manuscript. Although there is also a method of lowering the rate of setting UCR in order to avoid this problem, the merit of UCR of the above mentioned high rate will be lost.

[0006] The purpose of this invention is to offer the color picture formation equipment which can suppress the emphasis of the unnecessary edge of the black produced near the alphabetic character in a color background produced when the UCR parameter of high rate is set up. Moreover, other purposes are to offer the color picture formation equipment which can control generation of the unnecessary texture pattern produced when the manuscript drawn up by halftone dot which is represented by the printing manuscript is read.

[0007]

[Means for Solving the Problem] In the color picture processor with which this invention indicated by claim 1 forms a color picture using the color material of yellow, a Magenta, cyanogen, and Japanese ink in order to attain the above-mentioned purpose A means to detect the signal equivalent to the ink volume of an image, and a means to detect the signal equivalent to the amount of saturation of an image, It is in the configuration possessing a means to graduate the detected this amount of saturation, a means to detect the amount of edges of saturation using the this graduated amount of saturation, and a means to control the amount of lower color removal, and ink volume according to the amount of edges of the this detected saturation.

[0008] Moreover, invention indicated by claim 2 is set to yellow, a Magenta, cyanogen, and the color picture processor that forms a color picture using the color material of Japanese ink. A means to detect the signal equivalent to the ink volume of an image, and a means to detect the signal equivalent to the amount of saturation of an image, It is in the configuration possessing a means to detect the amount of saturation from this detecting signal, a means to detect the amount of edges of saturation using the this detected amount of saturation, and a means to control the amount of lower color removal, and ink volume according to the amount of edges of the this detected saturation.

[0009]

[Function] According to the configuration of invention indicated by claim 1, the signal equivalent to the ink volume of an image is detected. Unite and it has a means to graduate the amount of saturation which detected and this detected the amount of saturation. Emphasis of the unnecessary edge of the black produced near the alphabetic character in a color background is suppressed by controlling the initiation concentration of black print generation and lower color removal according to the amount of edges of the saturation which detected and this detected the amount of edges of saturation using the graduated this amount of saturation. Moreover, a smoothing circuit can omit and it becomes advantageous in cost by detecting and uniting the signal equivalent to the ink volume of an image, and controlling the initiation concentration of black print generation and lower color removal according to the amount of edges of the saturation which detected and this detected the amount of edges of saturation using the amount of saturation which detected and this detected the amount of saturation according to the configuration of invention indicated by claim 2.

[0010]
[Example] Hereafter, the example of this invention is explained. Drawing 2 shows an example of the outline system configuration of the color picture formation equipment concerning this invention. This example is explained using the outline configuration of the copying machine which performs four scans in all in yellow, a Magenta, cyanogen, and each phenomenon cycle of Japanese ink, and forms the color picture of one sheet.
[0011] In drawing 2 , the shading compensation circuit 1 amends variation between red, Green, and the blue pixel in a chip, quantity of light nonuniformity, etc. about each pixel, when it separated the color of and reads by the CCD sensor. The L* conversion circuit 2 changes into signal L*bgr of a lightness scale the signal of the reflection factor read by the CCD sensor, and changes the L*a*b conversion circuit 3 into a standard system value (L*a*b*) signal from signal L*bgr of a lightness scale. Here, a system value (L*a*b*) signal expresses lightness with L* shaft, and expresses saturation and a hue at the two-dimensional flat surface of a* shaft and b* shaft which intersects perpendicularly with this.
[0012] The HC conversion circuit 4 generates Hue (hue) and a Chroma (saturation) signal from a system value (L*a*b*) signal. The color tone ready circuits 5 are H+**H, L*+**L* or betaL*, the color adjustment by gammaC, and a thing that performs recognition of a color, and processing of conversion further. The a*b* conversion circuit 6 carries out inverse transformation to a*b* from a hue and a saturation signal. The YMC conversion circuit 7 changes system value (L*a*b) into the yellow of a record signal, a Magenta, and cyanogen. The lower color removal circuit 8 generates a black print, the UCR(ed) yellow, a Magenta, and cyanogen, and selects and outputs the chrominance signal doubled with the development color. Yellow, a Magenta, cyanogen, the thing to which sharpness is adjusted to a **** phenomenon chrominance signal, and the TRC conversion circuit 10 of a filter circuit 9 are the nonlinear gray scale conversion which suited the recording characteristic of IOT, and a thing which performs color-balance adjustment etc. further.
[0013] Next, lower color removal processing is explained in detail. The configuration of the lower color removal circuit applied to the color picture formation equipment of this invention at drawing 3 is shown. Here, the one where 0 of a value is larger as for the brighter one of a formation image and a value shall show the dark law of a formation image. The MAX detector 11 is a circuit which computes max (Y, M, C), and the MIN detector 12 is a circuit which computes min (Y, M, C). The saturation calculation circuit 13 calculates the value which computes max(Y, M, C)-min (Y, M, C), and is equivalent to saturation using the output of the MAX detector 11 and the MIN detector 12.
[0014] The smoothing circuit 15 is a filter circuit for graduating the applicable pixel circumference using the signal of the saturation held by the line buffer 14 of several lines. Although the example of 3x3 shows in this example, it does not restrict to especially this size and, generally defines as the size of mxn. Moreover, as a filter factor, a multiplier as shown, for example in drawing 4 is used. It can change with filter size, a smoothing property, etc., without, of course being limited to this.
[0015] The amount calculation circuit 16 of saturation adjustments is a circuit which determines which adjusts ink volume according to the amount of saturation from the value of min (Y, M, C) used as the radical which computes ink volume based on the graduated amount of saturation. The approach of adjustment reduces ink volume at a fixed rate, or chooses suitably setting up nonlinear relation using a look-up table (Look Up Table) etc., so that the amount of saturation of the pixel concerned graduated like Y=aX+b (the amount of Y:adjustments, the amount of saturation of which X:smoothing was done, a, b: multiplier for adjustment) is high.
[0016] The ink volume equalization circuit 22 is a circuit which subtracts the amount of saturation adjustments from min (Y, M, C). The edge extract circuit 18 is a filter circuit for extracting the amount of edges using the graduated signal of saturation which was held by the line buffer 17 of several lines. Although the example of 3x3 shows in this example, it does not restrict to especially this size and, generally defines as the size of mxn. Moreover, as a filter factor, a multiplier as shown, for example in drawing 5 is used. It can change with filter size, an edge extract property, etc., without, of course being limited to this.
[0017] The amount calculation circuit 19 of starting point (STP) adjustments computes the amount of

adjustments for changing black print generation of the pixel concerned, and the initiation concentration (henceforth the starting point) of lower color removal (UCR) from the amount of edges outputted from the edge extract circuit 18. The amount of starting point adjustments computed here With the ink volume determined in the ink volume equalization circuit 22, it sets in the amount calculation circuit 24 of UCR(s). for example, Yi=cixXi+di-Z (the amount of Y:UCR, X:ink volume, and the amount of Z:starting point adjustments --) c, d : The amount of UCR(s) is set up at a fixed rate, so that ink volume is high like the multiplier for adjustment, i=Yellow, Magenta, and Cyan. You may constitute so that the starting point may furthermore be adjusted, or you may enable it to set up the relation of Yi=cixXi+di using a look-up table.

[0018] In the aforementioned formula (Yi=cixXi+di), 100%, as UCR, although UCR will be performed from a white level if it is set as c= 1.0 and d= 0, the start point of UCR comes to be shifted as a result by the effectiveness of the amount of starting point adjustments of the pixel concerned. Line buffers 20 and 21 double the timing of the Rhine delay of a smoothing circuit. Y -- M -- C -- a signal -- an arithmetic circuit -- 25 -- setting -- UCR -- an amount -- subtracting -- having -- Y -- ' -- M -- ' -- C -- ' -- a signal -- becoming . Here, although the example of a configuration was shown that the amount of UCR(s) adjusts separately to Y, M, and C signals, each amount of UCR(s) of Y, M, and C signal may be constituted identically.

[0019] K' showed the configuration which can adjust ink volume according to the amount of UCR(s) in the ink volume generation circuit 23. For example, while adjusting the gradation of ink volume like Y=eX+f-Z (the amount of Y:Japanese-ink adjustments, X:ink volume, the amount of Z:starting-point adjustments, e, f: multiplier for adjustment), the start point of ink volume generation is shifted as a result by the effectiveness of the amount of starting point adjustments. You may constitute also here so that the relation of eX+f may be adjusted including a nonlinear property using a look-up table. Furthermore, although the common amount of starting point adjustments is inputted into the amount calculation circuit of UCR(s), and the ink volume generation circuit in this example, you may constitute so that the amount of UCR(s) and the separate amount of adjustments doubled with ink volume generation may be made to input.

[0020] A means to detect the signal with which the MAX detector 11, the MIN detector 12, and the saturation calculation circuit 13 are equivalent to saturation in drawing 3 here, Moreover, a means to detect the signal with which the MIN detector 12, a line buffer 21, and the ink volume equalization circuit 22 are equivalent to ink volume, Moreover, a means by which a line buffer 14, the smoothing circuit 15, and the amount calculation circuit 16 of saturation adjustments graduate the amount of saturation, Moreover, line BAAFFA 17 and the edge extract circuit 18 constitute further a means to detect the amount of edges of the amount of saturation, and a means by which the amount calculation circuit 19 of STP adjustments, the ink volume equalization circuit 23, and the amount calculation circuit 24 of UCR(s) control the amount of lower color removal, and ink volume according to the amount of edges.

[0021] Drawing 6 shows the example of a configuration which does not have a smoothing circuit as the 2nd example of this invention. Since according to this example line buffers 14 can be reduced from the configuration of drawing 3 and the capacity of line buffers 20 and 21 can be reduced further, there is an advantage that cost and a hardware scale are made small. Next, the concept of starting point adjustment is explained using drawing 7 . Although the sectional view of the direction of a single dimension of an image is used for explanation, when filter size is two-dimensional, it is accompanied by two-dimensional change in fact. Furthermore, in order to make it intelligible, when not graduating a saturation signal, it explains by the case where saturation adjustment is not applied.

[0022] In drawing 7 , (a) has shown the sectional view in the case of the blue alphabetic character in the yellow background shown on the above mentioned trouble which is a reading manuscript. If the manuscript of (a) is read with an image reader (IIT), it is supposed that the signal from which the edge received signal processing after a provincial accent and A/D conversion by MTF of IIT became as shown in (b). (c) is a signal equivalent to the saturation which shows the result of max-min, and (f) is a signal equivalent to the ink volume which shows min. That from which what covered the edge extract

filter over the signal of (c) extracted the negative component of an edge as an amount of STP adjustments further by becoming the signal of (d) is the (e) Fig. The result of having added the amount of STP adjustments shown by (e) to the ink volume signal of the above (f) is the (g) Fig., and the result of having added and UCR(ed) the amount of STP adjustments shown by (e) to the signal after 100% UCR of (h) is the (i) Fig. In this example, it turns out that the Japanese ink component produced according to a provincial accent is amended by the amount of STP adjustments, and generating of a black print is controlled.

[0023] The example of the relation between the amount of STP amendments in the amount calculation circuit of STP adjustments and an edge sampling volume is shown in drawing 8 (a). As the output which carried out edge detection is shown in drawing 8 (b), although a flat part is "0", the output of positive/negative will be taken out if there is an edge. When drawing 8 (a) detects the negative amount of edges among the outputs of positive/negative Amount of edges > n1 0 Amount <nof n1< edges 2 (m1/(n1-n2)) Amount +mof x edges 2 The amount of n2< edges m1 The amount of amendments is outputted by the above-mentioned relation. You may constitute from a look-up table etc., or may also incorporate as a circuit which calculates the above-mentioned relation so that the amount of adjustments as shown in drawing to the negative amount of components of an edge sampling volume may be outputted.

[0024] Although this example explained the signal equivalent to saturation using max(Y, M, C)-min (Y, M, C), it is not necessarily limited to this example, and the same effectiveness is acquired even if it uses saturation C* obtained from signals, such as L*a*b. Moreover, the same effectiveness is expectable also by making the signal which is equivalent to saturation from Y, M, and C with a certain function, or making from a look-up table. Moreover, although four scans in all are performed in yellow, a Magenta, cyanogen, and each phenomenon cycle of Japanese ink, the color picture of one sheet is formed and it is explained by this example, it does not necessarily restrict to the color picture formation process defined system of such a configuration. For example, you may be the so-called tandem configuration which outputs YMCK at once from the thing made into one line after the lower color stripper of drawing 2 , or 1 time of a scan/memory.

[0025]

[Effect of the Invention] As explained above, according to this invention, it becomes possible to suppress the emphasis of the unnecessary edge of the black produced near the alphabetic character in a color background produced when the UCR parameter of high rate is set up. It becomes possible to control generation of the unnecessary texture pattern produced when the manuscript drawn up by halftone dot which is furthermore represented by the printing manuscript is read.

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## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing for explaining reappearance when the RGB provincial accent by MTF fall arises.
[Drawing 2] It is the block diagram showing the example of a system configuration of the color picture formation equipment concerning the 1st example of this invention.
[Drawing 3] It is the block diagram showing the configuration of a lower color removal circuit.
[Drawing 4] It is drawing showing an example for explaining a smoothing circuit multiplier.
[Drawing 5] It is drawing showing an example for explaining an edge extract circuit multiplier.
[Drawing 6] It is the block diagram showing the example of a system configuration which does not have a smoothing circuit as the 2nd example of this invention.
[Drawing 7] It is drawing explaining the concept of starting point adjustment.
[Drawing 8] It is the explanatory view showing the example of the relation between the amount of STP amendments used by the amount calculation of STP adjustments, and an edge sampling volume.
[Description of Notations]
1 -- A shading compensation circuit, 2 -- L* conversion circuit, 3 -- L*a*b* conversion circuit, 4 [ -- YMC conversion circuit, ] -- HC conversion circuit, 5 -- A color tone ready circuit, 6 -- An a*b* conversion circuit, 7 8 [ -- MAX detector, ] -- A bottom color removal circuit, 9 -- A filter circuit, 10 -- A TRC conversion circuit, 11 12 -- A MIN detector, 13 -- A saturation calculation circuit, 14, 17, 20, 21 -- Line buffer, 15 [ -- The amount calculation circuit of STP adjustments, 22 / -- An ink volume equalization circuit, 23 / -- An ink volume generation circuit, 24 / -- The amount calculation circuit of UCR(s), 25 / -- Arithmetic circuit ] -- A smoothing circuit, 16 -- The amount calculation circuit of saturation adjustments, 18 -- An edge extract circuit, 19

[Translation done.]

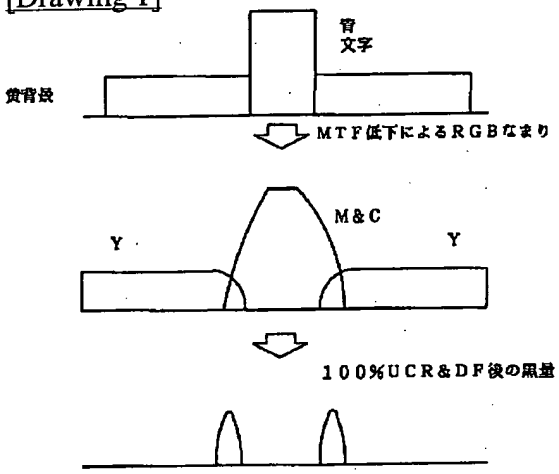
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## DRAWINGS

[Drawing 1]




[Drawing 4]

平滑化回路係数例

(a)

| | | |
|---|---|---|
| 1/16 | 1/8 | 1/16 |
| 1/8 | 1/4 | 1/8 |
| 1/16 | 1/8 | 1/16 |

(b)

| | | |
|---|---|---|
| 1/9 | 1/9 | 1/9 |
| 1/9 | 1/9 | 1/9 |
| 1/9 | 1/9 | 1/9 |

[Drawing 5]

エッジ抽出回路係数例

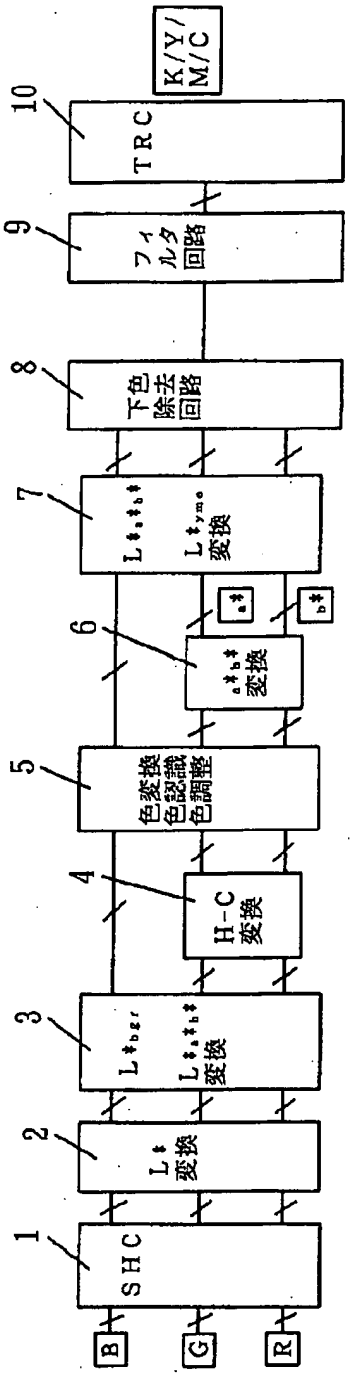
(a)

| | | |
|---|---|---|
| -1/16 | -1/8 | -1/16 |
| -1/8 | 6/8 | -1/8 |
| -1/16 | -1/8 | -1/16 |

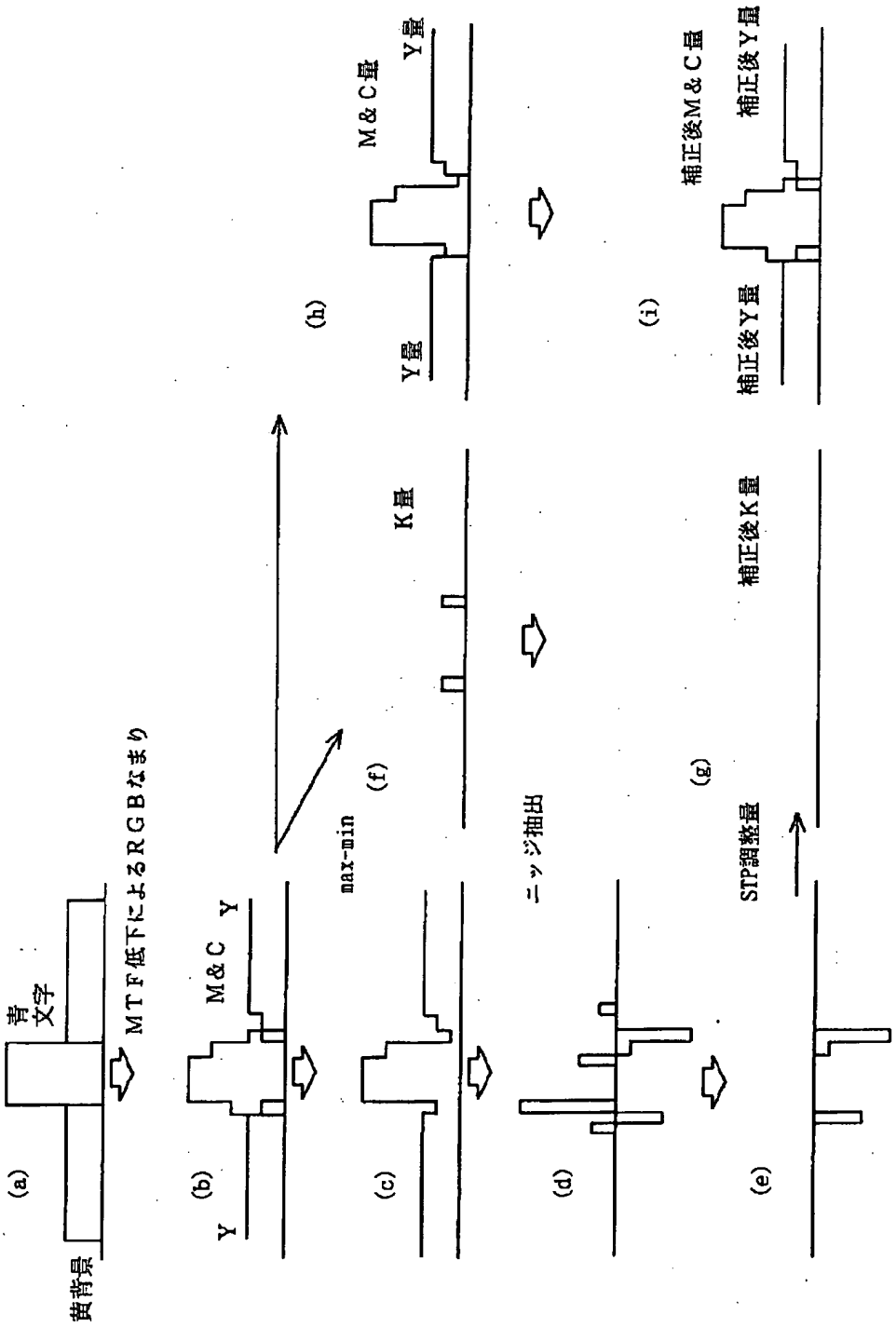
(b)

| | | |
|---|---|---|
| 0 | -1/2 | 0 |
| -1/2 | 2 | -1/2 |
| 0 | -1/2 | 0 |

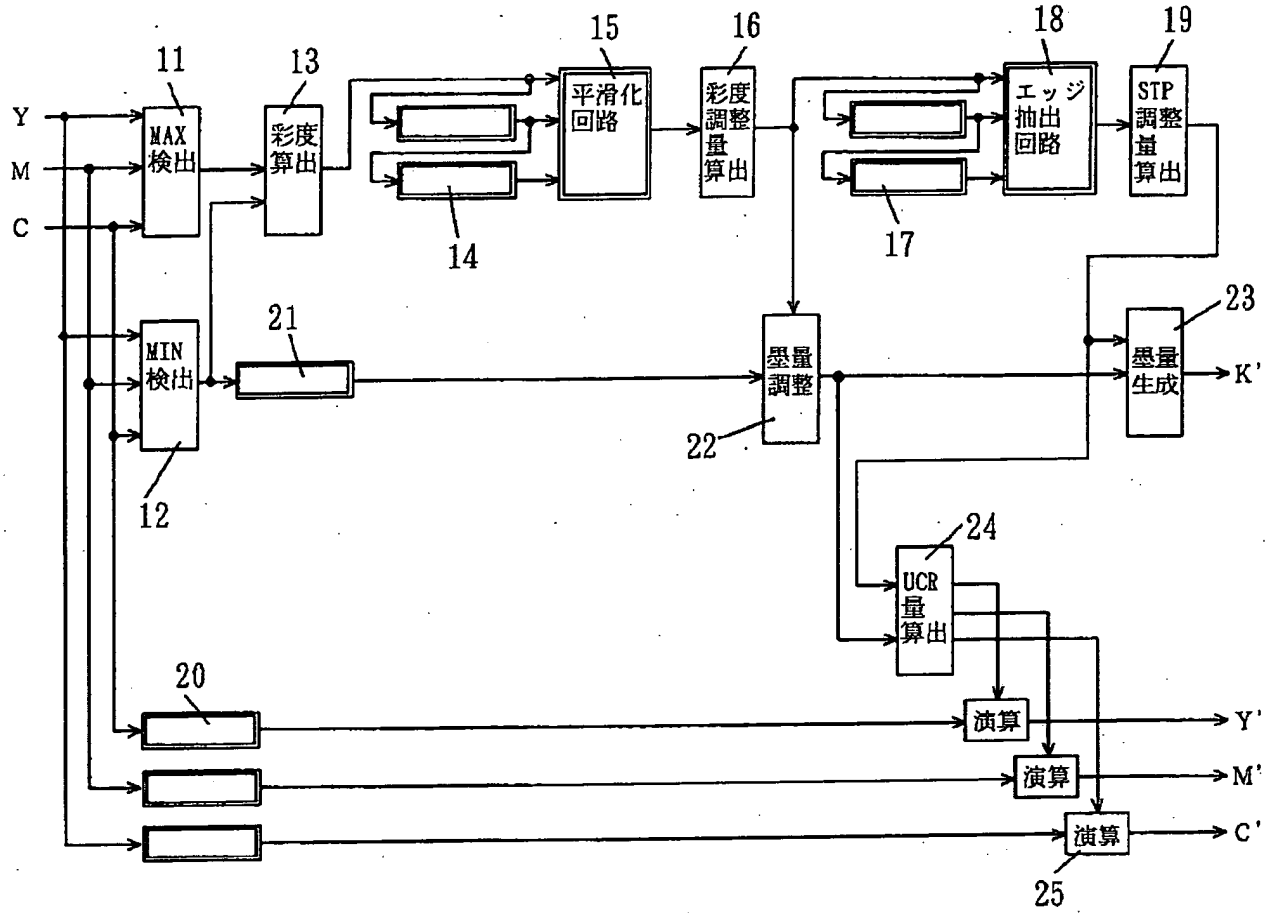
[Drawing 2]


K/Y/M/C
10
TRC
9
フィルタ回路
8
下色除去回路
7
変換
6
変換
5
色変換
色認識
色調整
4
H-C変換
3
変換
2
L*変換
1
SHC
B
G
R

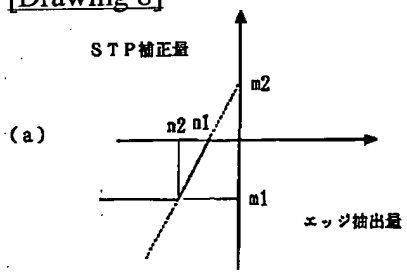
[Drawing 7]

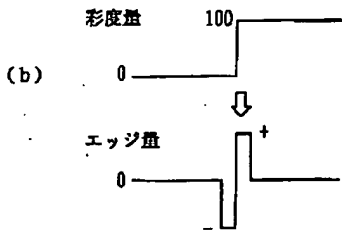

(a)
黄背景
青文字
MTF低下によるRGBなまり
(b)
Y
M&C Y
max-min
(c)
(f)
K量
ニッジ抽出
(d)
(h)
Y量
M&C量 Y量
(e)
STP調整量
(g)
補正後K量
(i)
補正後Y量
補正後M&C量 補正後Y量

[Drawing 3]

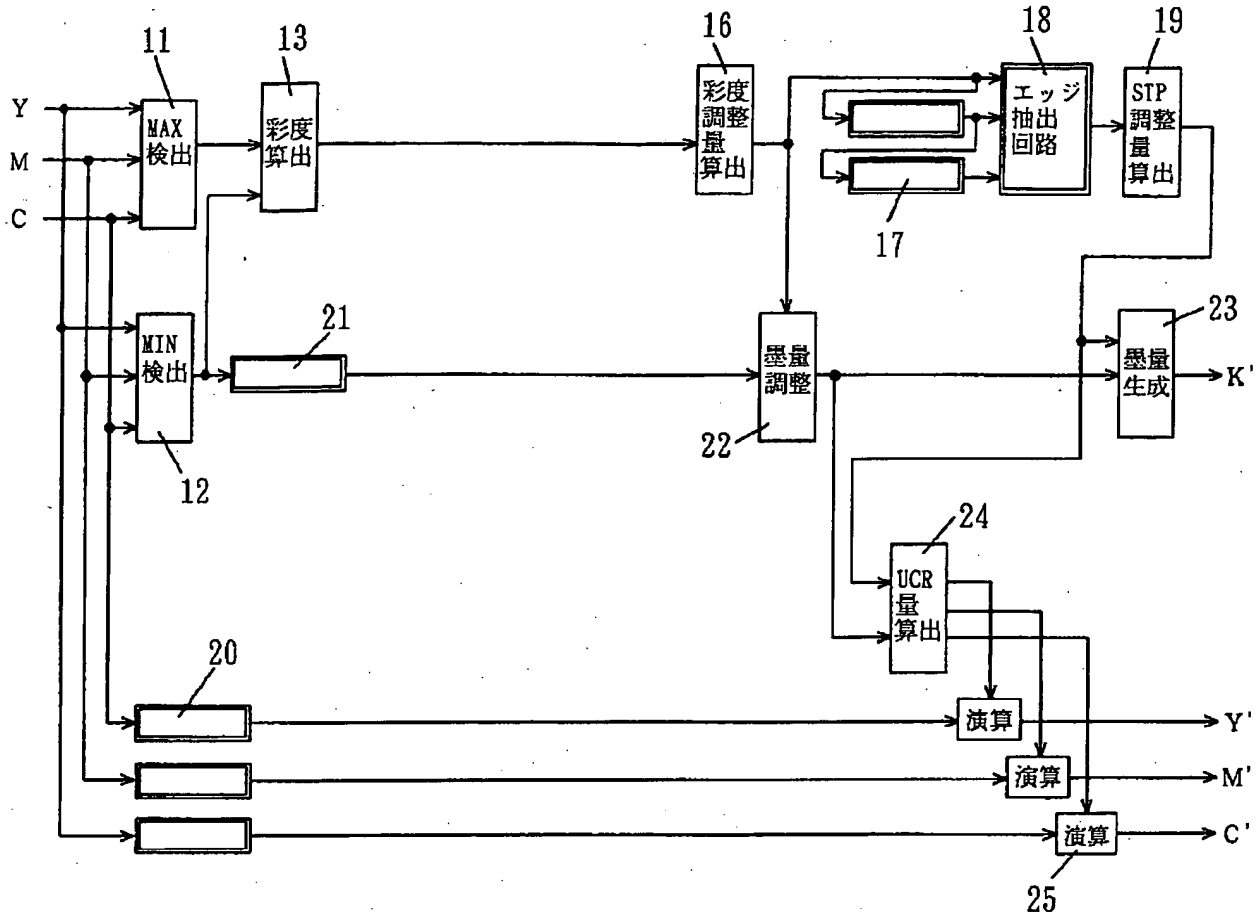



[Drawing 8]




[Drawing 6]




[Translation done.]